

XD575E
Design Calculations
Grating Equation
 $m\lambda = a(\sin \alpha + \sin \beta)$
 for $\alpha = \beta$
 $m\lambda = 2a \sin \beta$
 for 1st order, 1200 gr
 at 3500 Å
 $1 \times 3500 = 2 \times 833$
 $\beta = 12^\circ 6'$
Blaze Angle
 $\theta = \frac{1}{2}(\alpha + \beta)$
 $\theta = 12^\circ 6'$
 $2000 \times 0.5 \approx 10 \mu$
Aperture
 $f/\# = \frac{P}{d}$ Critical focal

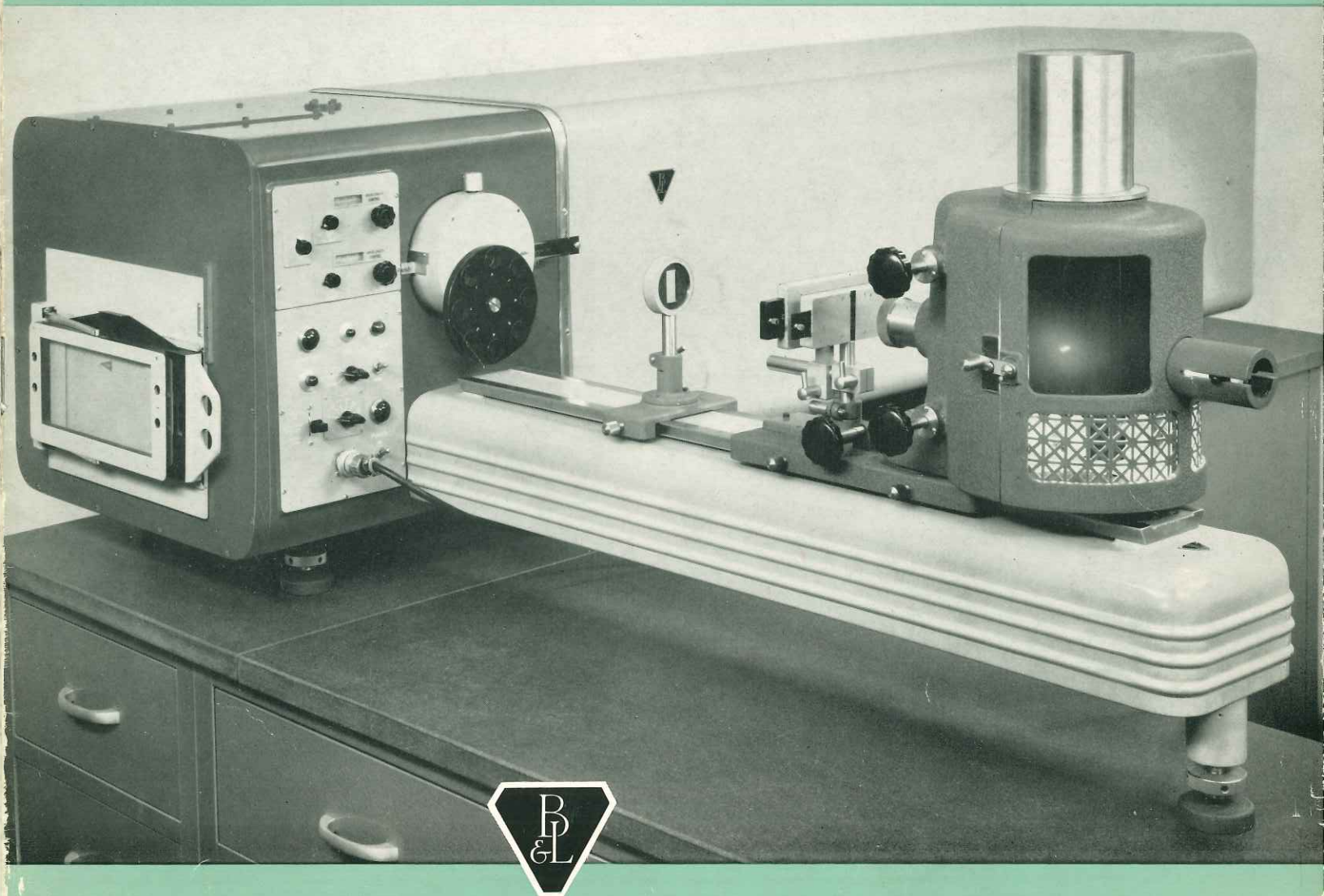
BAUSCH & LOMB

DUAL

U.S. Patent Office
 AUG 19 1955
 Design Division

Grating

SPECTROGRAPH



The DUAL Grating Spectrograph

Revolutionary in Design . . .

Revolutionary in Performance

TODAY'S pressing need in spectrographic analysis is for a compact instrument which affords a wide range of techniques, speedy and efficient operation, high resolution and dispersion, and economical, efficient maintenance. All of these needs have been met in the B&L DUAL Grating Spectrograph, to assure accurate and precise answers to today's problems and tomorrow's research.

The efficiency of any spectrograph is the sum of all its mechanical and optical components . . . but the heart of the instrument is the grating. The two gratings used in DUAL Grating Spectrograph are products of the world-renowned B&L grating ruling laboratory. Control over the manufacturing process from raw material to the finished grating assures highest quality. The superiority of Bausch & Lomb Certified-Precision Replica Gratings is attested to by their world-wide acceptance. Equal, or superior, to the original from which they were produced, a further advantage of the replicas is that, unlike originals, whose efficiency cannot be restored, the replicas can be realuminized.

FLEXIBILITY

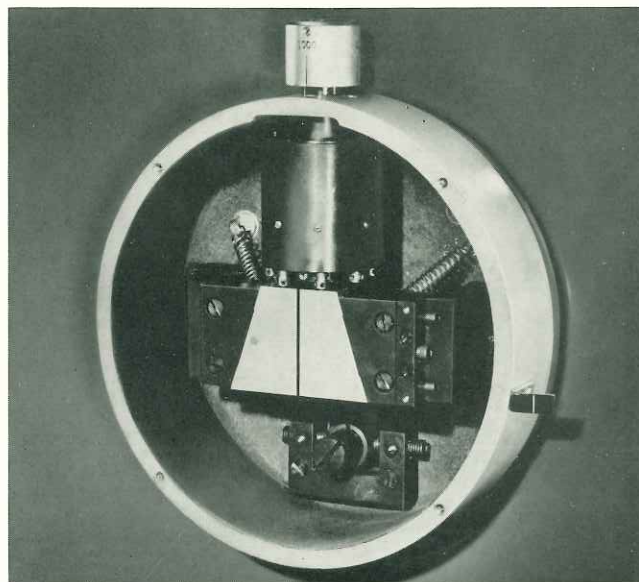
The two gratings operate independently and the desired wavelength area from each for a specific analysis is selected at the instrument panel with simple dial controls. Easy-to-read duplicate scales show range and spread at a glance. Complete range coverage assures quick pinpointing of the required spectral region.

The DUAL Grating has a flat field and does not require a curved plate, thus eliminating risk of plate breakage. It is designed to hold one 4" x 10", one 2" x 10", or two 2" x 10" glass plates. This permits the use of plates of different emulsion characteristics to take advantage of the unique dual grating feature of the spectrograph. Mechanical occluders for each grating are controlled by knobs on the instrument panel. Either knob may be set to zero when it is desired to use one grating only.

Separation of spectra is achieved by setting a dial on the instrument panel to permit spectra to be photographed one above the other on the same plate, or separated by a space of up to 50mm.

Sharp, clear spectra are assured by the extremely high resolution of this instrument—over 165,000 actual resolving power in the second order—surpassing the limit of present spectrographic emulsion resolution.

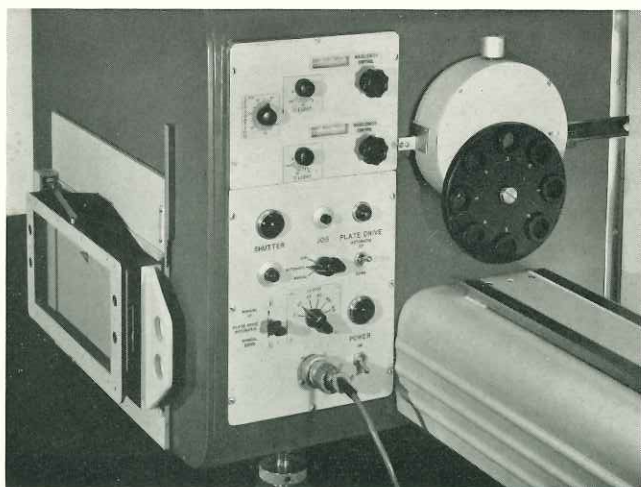
The use of two gratings provides great flexibility of dispersion. One grating has a dispersion of 8A/mm., first order, and 4A/mm., second order; the other, 4A/mm., first order, and 2A/mm., second order. The operator is assured of both the low dispersion necessary for recording of a complete spectrum and the high dispersion required for critical study of a complex range of that spectrum—with one exposure! The ranges desired are easily dialed from the instrument panel.



FAST, PRECISE SLIT OPERATION

Convenience and simplicity of operation are further extended by another exclusive feature—the Step-Variable Slit. (Pat. app. for.) It combines the advantage of the fixed slit for easy reproducibility (within $\pm .5$ micron) and the advantage of the variable slit for quick selection of slit width and easy cleaning. Four slit apertures are provided (10, 20, 50 and 1000 microns) any one of which is instantly selected simply by setting a control knob. Slit jaws can be opened wide for cleaning and, on release, will immediately return to their original setting. A conventional Hartmann slide, including V slide and 5 stepped apertures, is also standard equipment.

To permit quick, convenient selection of slit cover lenses and filters, a turret with 8 apertures is provided.

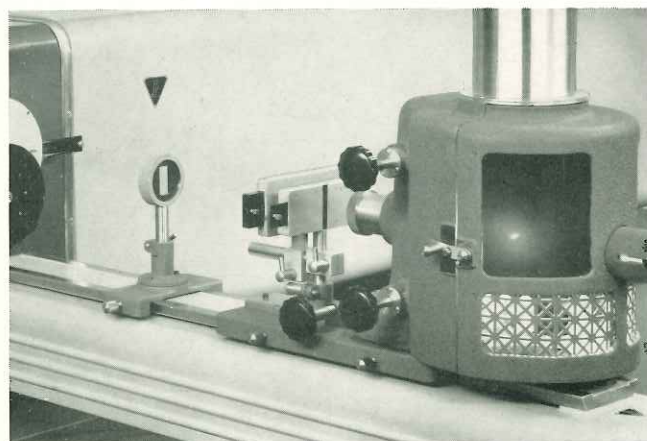


CLOSELY GROUPED AUTOMATIC & SEMI-AUTOMATIC CONTROLS

Saving the operator valuable time and reducing the likelihood of operational error, the DUAL Grating is provided with controls that make operation as nearly automatic as possible. All controls are grouped so that they are at the operator's fingertips at the plate-holder end of the instrument. The plate-holder is at convenient working level.

A push button controls the shutter for manual operation and a connection is provided for automatic timing devices. A red light indicates when the shutter is open.

To provide for the full range of spectrographic techniques, the DUAL Grating permits a choice of three different racking methods — manual, jog and automatic — thus insuring efficient adaptation to specific job requirements. Simple setting of a switch on the instrument panel selects the method desired and two others determine the direction and number of millimeters the plate will rack. A red signal lights when the plate has reached the limit of travel and movement automatically ceases.



Illuminating System with Safety Arc and Spark Stand.

THE ILLUMINATING SYSTEM

The unique use of two gratings in this instrument requires an illuminating system that provides an image of the arc for each grating. This is accomplished by the use of a bi-prism on the illuminating bed. One half of this bi-prism illuminates each grating. A step diaphragm is provided behind the bi-prism to mask out the electrodes. It is adjustable to conform to various gap widths and may also be used to select different portions of the arc for analysis. As the intensities of two different spectral ranges are not likely to be the same, the bi-prism is provided with a filmed step filter covering half of its surface. Various intensity ratios are available. A cylindrical lens can be used to provide more light, and to insure uniformity of lines. The usual slit cover lens is supplied as standard equipment.

Other optical components are available for special techniques and to allow use of a wide variety of arc and spark stands, including the Petrey stand.

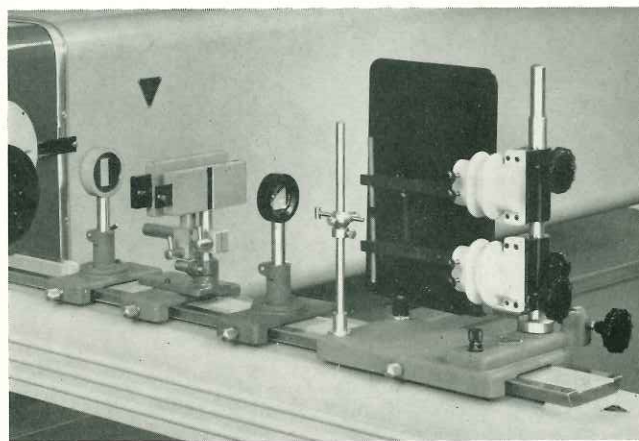
EASY MAINTENANCE

The dust-proof design of the DUAL Grating eliminates the annoyance and expense of frequent cleaning. There are only two openings to the interior of the instrument — the slit and the camera opening. The camera opening always remains covered either by the plate holder or a glass cover plate. In addition to providing protection against dust, this glass plate permits examination of spectra for instrument alignment and for identification in simple qualitative work.

COMPACT ATTRACTIVE DESIGN

Valuable floor space is saved by the compact design of the instrument. It measures only 2' x 7', less than half the space of other spectrographs of similar dispersion and resolution. For convenience of operation the 3' x 1/2' illuminating bed is at right angles to the slit. Weight is only 650 lbs.

Easy to keep clean, the surface is smooth—free from dust-catching recesses. The handsome, two-tone, baked enamel finish blends harmoniously with laboratory color schemes.



With Open Arc and Spark Stand.

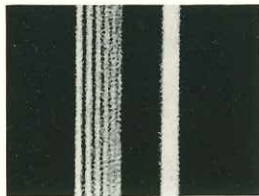
You will get low cost analyses with these DUAL

PRECISE AND CERTAIN DETERMINATIONS

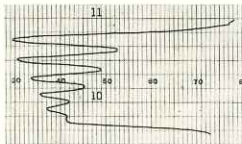
High Resolution

Resolves Praseodymium Line 5292.10A

Hyperfine Structure, showing 165,000 resolution, 2nd order with D.C. arc and 10 μ slit. ↓



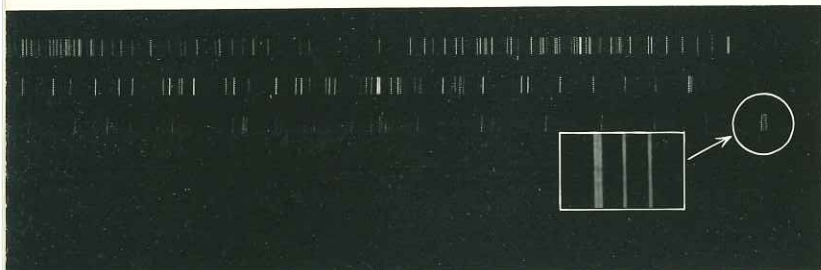
Microphotometer Trace, 5292.10A Line. ↓



Choice of Dispersions from Two Gratings

Iron Triplet—3100A group

Showing Dispersion: 1st order 4A/mm; 2nd order 2A/mm; 3rd order 1.33A/mm. Iron sample: D.C. arc; 10 μ slit. Grating: 4A and 2A/mm. ↓



Accurate Line Identification

Spectral lines adjacent without racking plate—Using Hartmann Diaphragm openings—For line identification work.

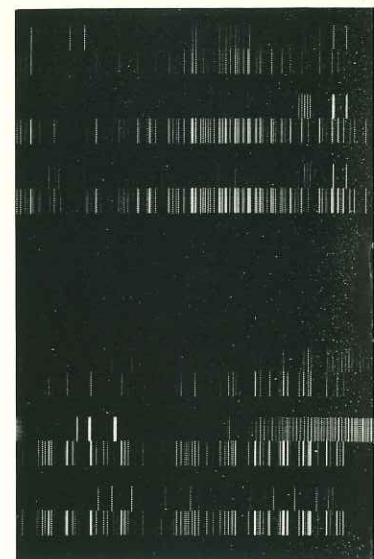
Samples: Different Matrix and Iron.

#1—Bureau of Standards #97 plus iron reference.

#2—Bureau of Standards #88 plus iron reference.

#3—Barium Stanate plus iron ref. D.C. arc; 20 μ slit; 40mm separation.

Grating: Upper group—8A and 4A/mm 2700A region; Lower group—4A and 2A/mm 3725A region. →



VERSATILITY

Choose your spectrum arrangement—separate by a selected distance

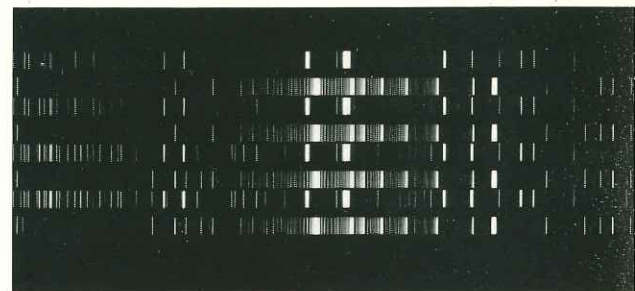
2 different ranges—6mm separation grouped by range.

Samples: Oil Standards.

D.C. arc; 20 μ slit.

Grating: 4A and 24/mm.

↓ Upper group—3500A region; Lower group—4200A region.



TIME SAVING LOW COST OPERATION WITH TWO GRATINGS

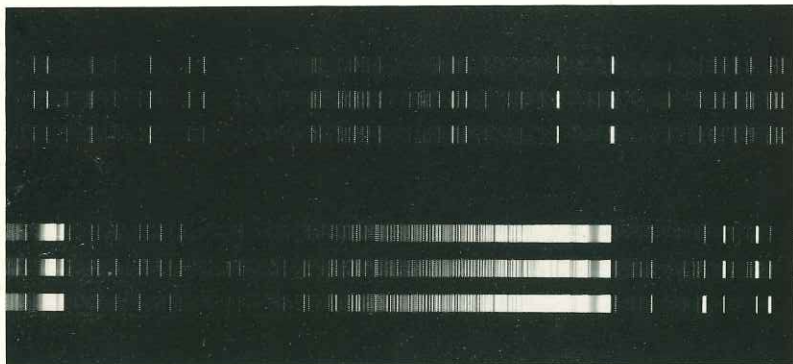
Long Range Spectra on single 10 inch plate

Photograph 2 ranges in single exposure, using both gratings.

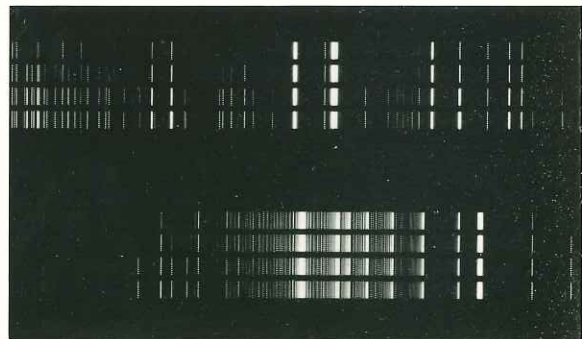
Sample: Silicates—Bureau of Standards #97, 98 and 102.

D.C. arc; 20 μ slit; 3mm separation.

Grating: Upper group—8A and 4A/mm—2800A region; Lower group—4A and 2A/mm—3750A region. ↓



2 different ranges—alternated—20mm separation; First row—3500A region; Second row—4200A region.



FLEXIBILITY

Use 2 different emulsions—single exposure on 2 separate plates, 2" x 10"

IL Plate—3100A region.

Sample: Silicates, Bureau of Standards #97, 98 and 102.

D.C. arc; 20 μ slit; 40mm separation.

Grating: 8A and 4A/mm. ↓



↑ SA #1 Plate—2800A region.

Sample: Silicates, Bureau of Standards #97, 98 and 102.

D.C. arc; 20 μ slit; 40mm separation.

Grating: 4A and 2A/mm.



Spectrograph features

SPEEDY OPERATION

Plate Racking—continuous, intermittent, manual, automatic

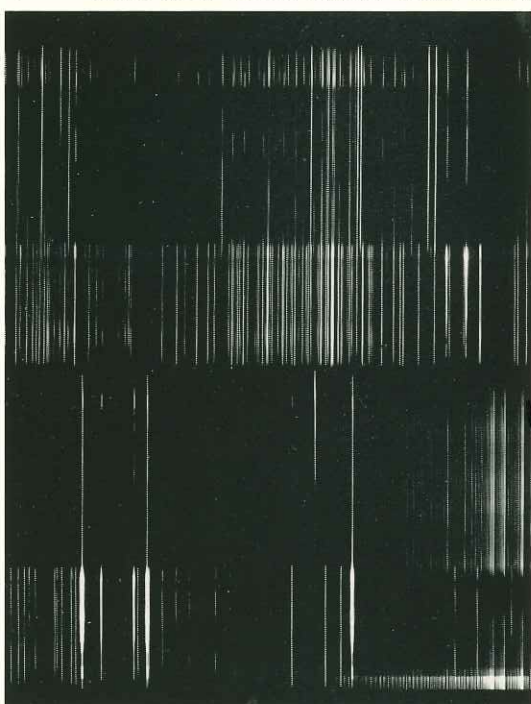
Continuously moving plate—moving plate technique sample burning continuously. Showing element volatilization at various rates and starting times.

Sample: Zinc, with 1% Oil Standard.

D.C. arc; 20 μ slit; 50mm separation.

Grating: Upper group 8A and 4A/mm—3400A region;

↓ Lower group 4A and 2A/mm—3900A region.



CONVENIENCE

Intermittent Exposure—"Jog Plate"

Moving plate technique with sample burning continuously—Lines adjacent.

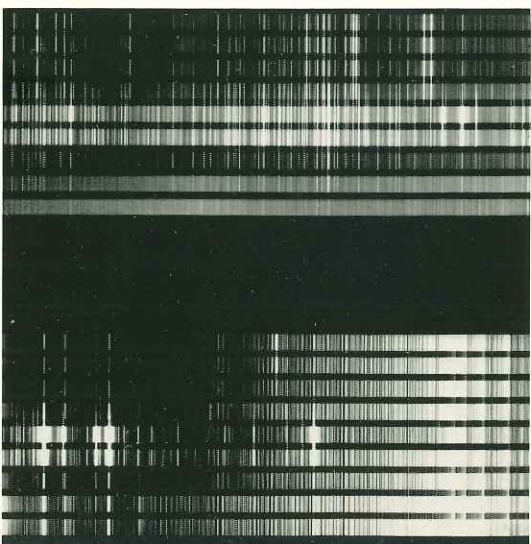
Sample: Zinc with 1% Oil Standard.

D.C. arc; 20 μ slit; 42mm separation.

Grating: Upper group—8A and 4A/mm—3400A region;

Lower group—4A and 2A/mm—3900A region.

PLUS: Automatic racking of plate to next preset position at end of exposure—prevents double exposure.



RARE EARTH ELEMENTS

Samples: #1—Rare Earth Mixture.

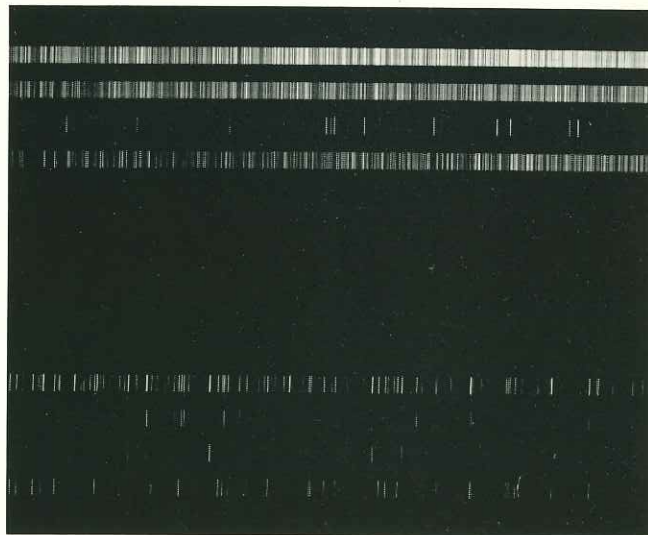
#2—Cerium.

#3—Lanthanum.

#4—Neodymium.

D.C. arc; 20 μ slit; 40mm separation.

Grating: Upper group—8A and 4A/mm 3200A region; Lower group—4A and 2A/mm 8000A region.



U. S. Patent Office

AUG 19 1955

Design Division

FERROUS ALLOYS

Samples: #1—Stainless Steel.

#2—Stainless Steel.

#3—Low Alloy Steel.

#4—Low Alloy Steel.

Spark Excitation; 20 μ slit; 35mm separation.

Grating: Groups 1 and 2—8A and 4A/mm 2800A region; groups 3 and 4—4A and 2A/mm 3800A region.

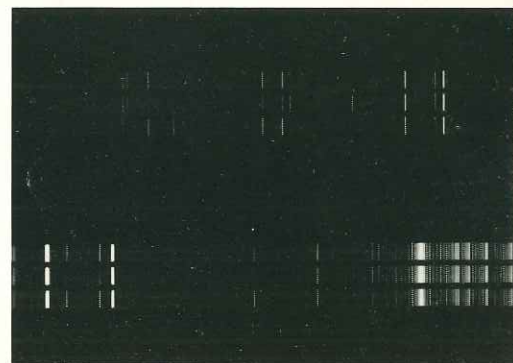


BIOLOGICAL SAMPLES LEAF ANALYSIS

Samples: Leaves (3 samples).

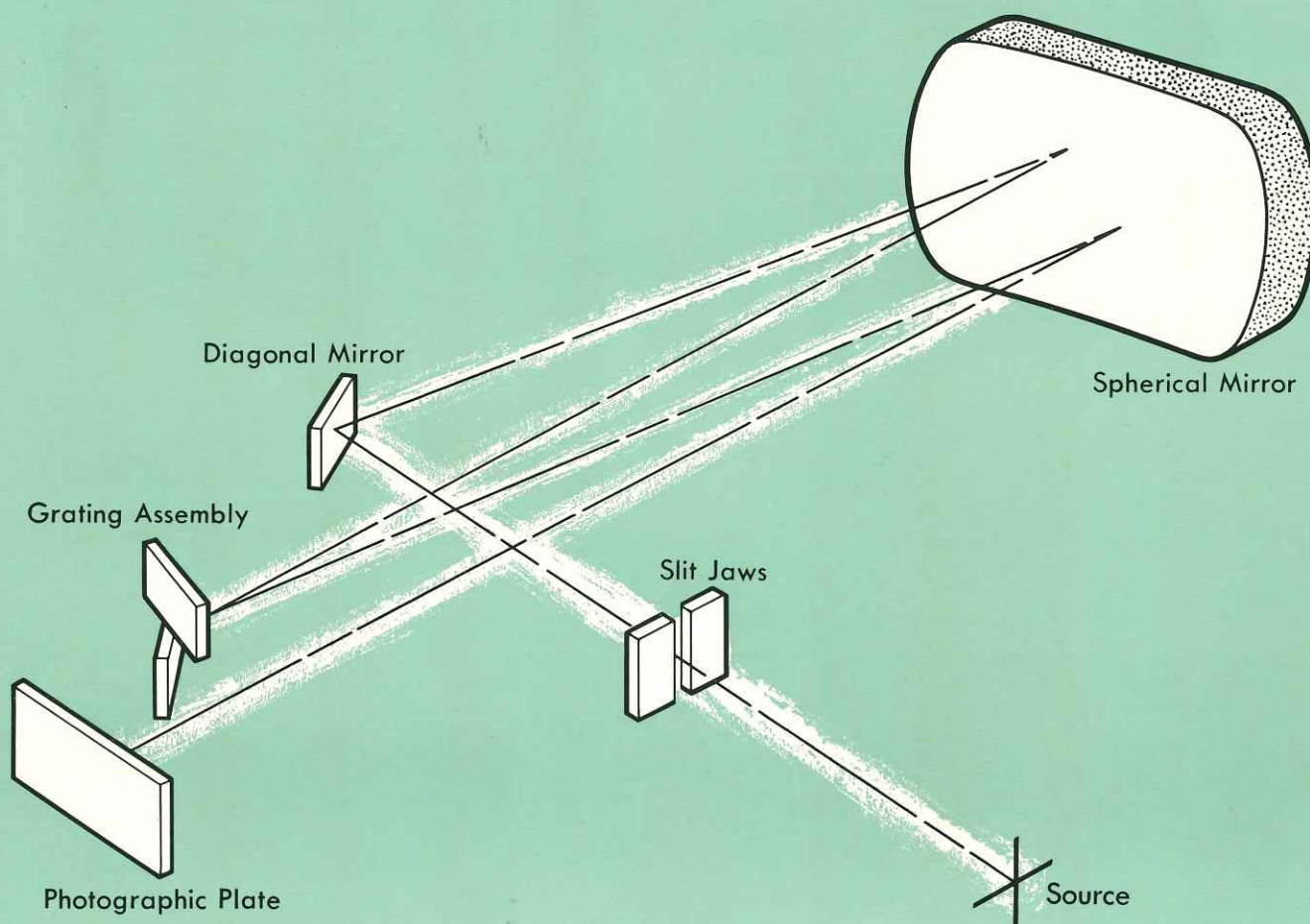
Uni-directional arc excitation with rotating (direct method) 20 μ slit; 20mm separation.

Grating: Upper group — 8A and 4A/mm 3050A region; Lower group—4A and 2A/mm 4050A region.



Short range spectra reproduced are natural size sections of 10 inch plates. Region designations are approximate midpoints of the spectra reproduced, and given in angstroms. Wavelength increases to right. SA#1 plate used unless otherwise stated. Quality is somewhat less than on original plates due to limitations in the many steps of reproduction. Spectra plates made by National Spectrographic Laboratories.

Path of Light in DUAL Grating Spectrograph



	600 groove/mm grating	1200 groove/mm grating
Grooves per mm	600	1200
Blaze	6000A	3000A
First Order Range	1850A-24000A	1850A-12000A
Dispersion	8A/mm	4A/mm
Second Order Range	1850A-12000A	1850A-6000A
Dispersion	4A/mm	2A/mm
Third Order Range	1850A-8000A	1850A-4000A
Dispersion	2.6A/mm	1.3A/mm
Spectral range covered on 10" photographic plate	2000A	1000A

Spectrograph: 2 ft. x 7 ft. **Accessory Bed:** ½ ft. x 3 ft. **Shipping weight:** Crated 800 lbs.

SPECIFICATIONS

Catalog No.

33-83-45-01	Dual Grating Spectrograph, with two gratings of 600 and 1200 grooves per mm, giving dispersions of 8A/mm and 4A/mm, 1st order and 4A/mm and 2A/mm, 2nd order; one 33-83-46 plate holder to take one 4"x10" or two 2"x10" plates; accessory bed on support base; Step-Variable slit assembly with fixed slits of 10, 20, 30 and 1000 micron widths; slit cover lens; automatic shutter; electrical controls, for 115-v, 60 cycle line operation, as described
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ILLUMINATING EQUIPMENT

	For use with 33-84-39 Safety Arc & Spark Stand:
33-83-26	Condenser and Tube Assembly to replace regular Quartz Condenser Assembly
33-83-47	Bi-prism-Filter-Field Lens Assembly for attaching to base of 33-84-39 stands
33-83-29-01	Cylindrical Condensing Lens Assembly, including 33-84-38 Clamp Base NOTE: Purchaser's B&L Safety Arc & Spark Stand to be sent to our factory for attaching Bi-prism Assembly and alignment with Spectrograph
	For use with 33-84-66 Open Type Arc & Stand, Petrey, or similar type stands:
33-83-28-01	Spherical Condenser in ring mount, including 33-84-38 Clamp Base
33-83-48	Bi-prism-Filter-Field Lens Assembly with Clamp Base
33-83-29-01	Cylindrical Condensing Lens Assembly, including 33-84-38 Clamp Base

ACCESSORIES AND SUPPLIES

33-84-39	Arc & Spark Stand, Safety (without condenser and tube mounting)
33-84-66	Arc & Spark Stand, Open Type
33-83-46	Plate Holder
33-84-91-01	Densitometer
33-84-74	Recorder
33-84-09	Electrode Shaper
33-84-70-11	Spectrum Viewing Box for 115-v. A.C. or D.C.
81-34-97-20	Spectrum Magnifier with mm scale for examining spectrum plates
33-84-62	Spark Generator
	Filter Lens, two step, quartz; 21mm diameter, 421mm E.F. for turret:
33-84-16	100% and 10% transmission (nominal)
33-84-17	100% and 35% transmission
33-84-23	100% and 65% transmission
	3 step: 100%, 25% and 6% transmission (Other filters made to special order. Information on request.)
33-84-64-01	Sector Mount, with universal motor and rheostat (115-v. A.C. or D.C.) and Clamp Base
33-84-59	Adjustable Sector Disc
33-84-58	Logarithmic Step Sector Disc (Interchangeable with 33-84-59)
33-84-61	Electrodes, regraphitized, AGS regular, $\frac{5}{16}$ " diameter, 12" long, in packages of 100
33-84-63	Electrolytic Iron Rods, 5mm diameter, 6" long

REPLACEMENT PARTS

71-71-64	Lamp for Power Switch Light, 6-w., 120-v
71-71-64	Lamp for Shutter Light
	NE-51, Fluorescent Lamp for Plate Drive Light
	Condenser Lens, Quartz, Spherical 40mm diameter, 71.5mm E.F., unmounted, for 38-83-26 and 33-83-28-01

TERMS AND PROCEDURE

CATALOG NUMBERS

When ordering, be sure to give catalog number and name of item.

FINANCIAL STANDING

To avoid delay, a purchaser with whom Bausch & Lomb has not previously transacted business should accompany his first order with commercial references or remittance in cash.

TRANSPORTATION CHARGES

Unless otherwise stated on a B&L quotation, all consumer purchases, except repairs, will be shipped transportation charges prepaid to any point within Continental United States of America. Other-than-consumer purchases, all repairs, and goods for delivery outside the above specified area will be shipped f.o.b. Rochester, N. Y., U. S. A. The shipping charges on products sent on memorandum are not prepaid. There is no charge for packing unless otherwise stated. Products made on special order cannot be forwarded C. O. D.

SHORTAGE OR DAMAGE

To avoid error, Bausch & Lomb exercises the utmost care in checking and packing all shipments. All packing should be carefully examined for small items. If a discrepancy is found, report it to Bausch & Lomb immediately. Report to the transportation company at once any claim for loss, damage or breakage. Carriers are responsible for loss or damage to goods in transit. When shipping container shows damage, do not give a clear receipt, but sign for "in bad order." Save the container and obtain an inspection report from the carrier.

RETURNING GOODS

If it is desired to return goods, first send Bausch & Lomb full

information by letter. Goods should not be returned for any reason until approval for their return has been received from Bausch & Lomb. Each item should be plainly tagged with sender's name and address. Identification tags will be sent on request.

ELECTRICAL EQUIPMENTS

Electrical equipments for use on voltages other than those listed are available on special order. Send complete specifications for quotations.

INQUIRIES

When writing, please give the date of your order, the Bausch & Lomb order number which appears on the packing slip and, if possible, the Bausch & Lomb invoice number.

PRICES

Prices are subject to change without notice. Orders are subject to acceptance at Rochester, N. Y., U. S. A., at prices prevailing at time of shipment. Orders for standard items may be cancelled if not wanted because of price advance. Excise taxes or other governmental charges will be added wherever applicable. Shipments to points outside Continental United States of America and to its territories, dependencies and possessions, except Hawaii and Alaska, are not subject to excise taxes. Delivery dates are estimated and cannot be guaranteed.

DESIGN CHANGES

Bausch & Lomb reserves the right to make changes in instrument design in accordance with scientific progress, and to supply apparatus resultingly different from that described or illustrated in its literature.



BAUSCH & LOMB OPTICAL CO.

Rochester 2, New York, U. S. A.

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U. S. Patent Office
AUG 19 1955
Design Division

PRICE LIST FOR CATALOG D-272

DUAL GRATING SPECTROGRAPH

U. S. Patent Office

AUG 19 1955

MARCH 1, 1955

Design Division
Price

Catalog No.

Specifications

33-83-45-01	Dual Grating Spectrograph, with two gratings of 600 and 1200 grooves per mm, giving dispersions of 8A/mm and 4A/mm, 1st order and 4A/mm and 2A/mm, 2nd order; one 33-83-46 plate holder to take one 4"x10" or two 2"x10" plates; accessory bed on support base; Step-Variable slit assembly with fixed slits of 10, 20, 30 and 1000 micron widths; slit cover lens; automatic shutter; electrical controls, for 115-v, 60 cycle line operation, as described	\$9300.00
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ILLUMINATING EQUIPMENT

	For use with 33-84-39 Safety Arc & Spark Stand:	
33-83-26	Condenser and Tube Assembly to replace regular Quartz Condenser Assembly.....	\$ 90.00
33-83-47	Bi-prism-Filter-Field Lens Assembly for attaching to base of 33-84-39 stands.....	\$ 270.00
33-83-29-01	Cylindrical Condensing Lens Assembly, including 33-84-38 Clamp Base.....	\$ 137.00
	NOTE: Purchaser's B&L Safety Arc & Spark Stand to be sent to our factory for attaching Bi-prism Assembly and alignment with Spectrograph.....	No Charge
	For use with 33-84-66 Open Type Arc & Spark Stand, Petrey, or similar type stands:	
33-83-28-01	Spherical Condenser in ring mount, including 33-84-38 Clamp Base.....	\$ 115.00
33-83-48	Bi-prism-Filter-Field Lens Assembly with Clamp Base.....	\$ 270.00
33-83-29-01	Cylindrical Condensing Lens Assembly, including 33-84-38 Clamp Base.....	\$ 137.00

ACCESSORIES AND SUPPLIES

33-84-39	Arc & Spark Stand, Safety (without condenser and tube mounting).....	\$ 600.00
33-84-66	Arc & Spark Stand, Open Type.....	\$ 275.00
33-83-46	Plate Holder	\$ 200.00
33-84-91-01	Densitometer	\$6000.00
33-84-74	Recorder	\$ 662.00
33-84-09	Electrode Shaper	\$ 220.00
33-84-70-11	Spectrum Viewing Box for 115-v. A.C. or D.C.....	\$ 45.00
81-34-97-20	Spectrum Magnifier with mm scale for examining spectrum plates.....	\$ 20.00
33-84-62	Spark Generator	\$ 535.00
	Filter Lens, two step, quartz; 21mm diameter, 421mm E.F. for turret:	
33-84-16	100% and 10% transmission (nominal).....	\$ 60.00
33-84-17	100% and 35% transmission	\$ 60.00
33-84-23	100% and 65% transmission	\$ 60.00
	3 step: 100%, 25% and 6% transmission.....	\$ 70.00
	(Other filters made to special order. Information on request.)	
33-84-64-01	Sector Mount, with universal motor and rheostat (115-v. A.C. or D.C.) and Clamp Base....	\$ 80.00
33-84-59	Adjustable Sector Disc.....	\$ 66.00
33-84-58	Logarithmic Step Sector Disc (Interchangeable with 33-84-59).....	\$ 28.00
33-84-61	Electrodes, regraphitized, AGS regular, $\frac{5}{16}$ " diameter, 12" long, in packages of 100.....	\$ 22.00
33-84-63	Electrolytic Iron Rods, 5mm diameter, 6" long, each.....	\$ 1.40

REPLACEMENT PARTS

71-71-64	Lamp for Power Switch Light, 6-w., 120-v.....	\$.19
71-71-64	Lamp for Shutter Light.....	\$.19
	NE-51, Fluorescent Lamp for Plate Drive Light.....	\$.19
	Condenser Lens, Quartz, Spherical 40mm diameter, 71.5mm E.F., unmounted, for 38-83-26 and 33-83-28-01	\$ 85.00

For detailed description of Accessories see Catalog D-20

Prices herein are subject to change without notice. Orders are subject to acceptance at Rochester, N. Y., U.S.A., at prices prevailing at time of shipment. Orders for standard items may be cancelled if not wanted because of price advance. Excise taxes or other governmental charges will be added wherever applicable. Shipments to points outside Continental United States of America and to its territories, dependencies and possessions, except Hawaii and Alaska, are not subject to excise taxes. Delivery dates are estimated and cannot be guaranteed.

BAUSCH & LOMB OPTICAL CO.

ROCHESTER 2, NEW YORK, U. S. A.